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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

JOSEPH G. SUPINA et al.

Serial No.: 10/605,315

Filed: September 22, 2003

Group Art Unit: 3618

Examiner: Bridget D. Avery

For: HYBRID VEHICLE POWERTRAIN WITH IMPROVED REVERSE DRIVE PERFORMANCE

Attorney Docket No.: 81044241/FMC1531PUS

**APPEAL BRIEF UNDER 37 C.F.R. § 41.37**

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Sir:

This is an appeal from the final rejection of claims 1-11 in the Office Action mailed on April 7, 2006 in the patent application identified above.

**I. REAL PARTY IN INTEREST**

The real party in interest is Ford Global Technologies, LLC ("Assignee"), a corporation organized and existing under the laws of the state of Delaware, and having a place of business at One Parklane Boulevard, Suite 600, Parklane Towers, East, Dearborn, Michigan 48126, as set forth in the assignment recorded in the U.S. Patent and Trademark Office on September 22, 2003, at Reel 013987/Frame 0625. Ford Global Technologies, LLC is a

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Name of Person Signing

Donald J. Harrington  
Signature

wholly-owned subsidiary of Ford Motor Company. An Assignment of the inventors' interest to Ford Motor Company was recorded on September 22, 2003 at Reel 013987/Frame 0621. The address of Ford Motor Company is The American Road, Dearborn, Michigan 48121. Ford Motor Company and Ford Global Technologies, LLC are corporations organized and existing under the laws of the State of Delaware.

## **II. RELATED APPEALS AND INTERFERENCES**

There are no appeals nor interferences known to the Appellants, the Appellants' legal representative, or the Assignee that will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

## **III. STATUS OF CLAIMS**

Claims 1-11 are pending in this application. Claims 1-11 have been rejected and are the subject of this appeal.

## **IV. STATUS OF AMENDMENTS**

An amendment after final rejection under 37 C.F.R. § 1.116 was filed on June 8, 2006, which made a minor editorial change in claims 1 and 2 at the last line of claim 1 and at line 12 of claim 2. Entry of this amendment was denied in an Office Action mailed June 30, 2006.

A request for reconsideration of the Final Rejection was filed by Appellants on June 8, 2006 concurrently with the amendment under 37 C.F.R. § 1.116. There was no response from the Examiner to Appellants' request for reconsideration.

A second request for reconsideration of the final rejection was mailed on August 16, 2006. No response from the Examiner to the second request for reconsideration has been received as of the date of mailing of this Appeal Brief.

## **V. SUMMARY OF CLAIMED SUBJECT MATTER**

The invention has two embodiments shown, respectively, in Figures 2 and 3 of Appellants' drawings. The invention of independent claim 1 is a hybrid electric vehicle powertrain shown in Figure 2, which includes an engine, an electric motor, an electric generator and a battery. These are identified in the embodiment of Figure 2, respectively, by numerals 54, 74, and 40. The battery is shown at 18 in Figure 1 and in Figure 1a. The invention of independent claim 2 is a hybrid electric vehicle powertrain shown in Figure 3.

There are two power sources in each embodiment. One power source is an electrical power source that comprises a motor, a generator and a battery. The other power source is the engine. A geared transmission, shown in Figure 2 at 46, 64, 66, 68 and 76 has power flow paths from the power sources to the traction wheels of the vehicle. A first element of the transmission, which is a planetary carrier 52 of the gear unit 46, is connected to the engine. A second element of the transmission is the ring gear 48, which is drivably connected to the motor through clutch 62. The third element of the gear transmission is the sun gear 50, which is connected to the rotor 44 of the generator 40. A reaction brake, shown at 60 in Figure 2, anchors the ring gear 48 as the engine drives the generator during reverse vehicle driving operation. The motor 74 is connected through the geared transmission to the traction wheels. When the clutch 62 is disengaged, the motor 74 becomes isolated from the ring gear 48. When the clutch 62 is engaged and the brake 60 is disengaged, the powertrain operates in a split power delivery mode for forward vehicle driving. This corresponds to the normal forward driving mode for the transmission shown in Figure 1.

When the vehicle is operating in reverse, the engine can drive the generator to charge the battery, which in turn powers the motor. The motor operates in a reverse direction during reverse vehicle drive and in a forward direction during normal forward vehicle driving in a split power delivery mode. The motor can be isolated from the ring gear during reverse drive by disengaging clutch 62. There is no need, therefore, for the motor in Appellants' invention of either Figures 2 and 3, to overcome reaction torque on the ring gear. Full driving torque of the motor then can be delivered to the wheels, which enhances reverse drive

performance for the vehicle compared to reverse drive performance for the powertrain of Appellants' invention. Further, the battery, which powers the motor, can be kept at a high state-of-charge in Appellants' invention since the engine in this operating mode is capable of driving the generator to charge the battery. The planetary gear unit that establishes a torque flow path from the engine to the generator includes ring gear 48, which can be braked by the brake 60.

Claim 2 defines the embodiment of the invention shown in Figure 3. This embodiment, like the embodiment of Figure 2, includes an engine, an electric motor, an electric generator and a battery. The motor, the generator and the battery are electrically connected to form an electrical power source. As in the case of the embodiment of Figure 2, the engine forms the other power source. Claim 3, which is dependent on claim 2, defines the clutch 88, which locks-up the planetary gearing to effect direct drive torque delivery between the engine and the generator.

The gearing of the Figure 3 embodiment includes a planetary gear set having a ring gear 48', a sun gear 50' and a carrier 52'. The carrier, which is the first element of the planetary gear set, is connected to the engine. The ring gear 48', which is the second element of the planetary gear set, is drivably connected to the vehicle traction wheels and to the motor through clutch 90, which is identified in claim 2 as a second clutch. Another clutch 88, which is identified in claim 2 as a first clutch, drivably connects the engine with the ring gear 48' when the powertrain is in a forward drive, power-split mode.

The second clutch 90 is disengaged and the first clutch 88 is engaged during reverse drive. As in the case of the embodiment of Figure 2, the motor, shown at 74', rotates in a reverse direction during reverse vehicle operation. When the second clutch 90 is disengaged and the first clutch 88 is engaged during reverse drive, the engine drives the generator with a one-to-one ratio so that the generator can charge the battery through a torque flow path that is isolated from the reverse drive torque flow path.

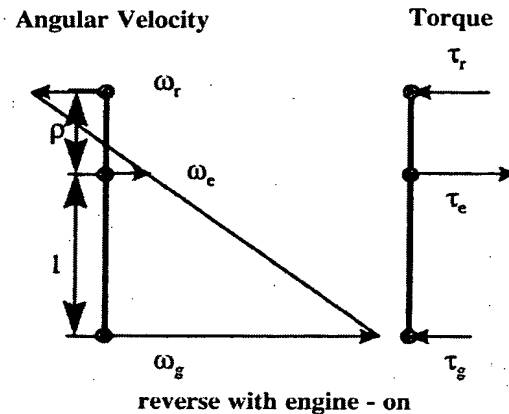
Independent claim 11 is generic to both the embodiment of Figure 2 and the embodiment of Figure 3. As in the case of claims 1 and 2, claim 11 recites a motor, shown

at 74 of Figure 2 and 74' of Figure 3, a generator shown at 40 in Figure 2 and 40' in Figure 3, and an engine shown at 54 in Figure 2 and 54' in Figure 3. The motor, the generator and the battery form an electrical power source. The engine forms another power source.

Claim 3, as in the case of claims 1 and 2, defines a geared transmission including a planetary gear set with a first gear element, which is the planetary carrier, a second gear element, which is the ring gear 48' and a third gear element, which is the sun gear 50'. The generator 40' is connected to the sun gear 50'.

Claim 11 defines a means for establishing a driving connection between the engine and the generator through the planetary gear elements during operation in a reverse vehicle driving power delivery mode. This permits the engine to drive the generator during a reverse vehicle driving power delivery mode so that the generator can charge the battery, which in turn powers the motor in a reverse vehicle driving direction. The motor torque flow path is isolated from the torque flow path between the engine and the generator, as previously explained. Clutch 88, when engaged, completes a torque flow path from the engine to the generator.

For the purpose of an explanation of the kinematics involved in operating the powertrains of Figures 2 and 3, reference will be made to the following sketch of a lever analogy for the planetary gearing of Figure 1. This technique of using a lever analogy as a tool in a planetary gear transmission analysis is often used in the automotive industry. This technique was published in 1981 by H. Benford and M. Leising in SAE Paper 810102. Since there is only one planetary gear set, the diagram in the following sketch of a planetary gear set lever analogy is quite simple:



The sketch shows a vector representation of the torque and the angular velocity for each element of a planetary gear set of the type shown in Figure 1 during reverse vehicle drive with the engine on. In this operating mode, the generator angular velocity is indicated by the symbol  $\omega_g$ . The engine speed, which is equal to the angular velocity of the carrier, is indicated by the vector  $\omega_e$ . The angular velocity of the ring gear is represented by the symbol  $\omega_r$ .

As previously explained, during reverse drive of the vehicle powertrain shown in Figure 1, the motor drives in a direction opposite to its direction of motion during forward drive. For purposes of this explanation, the direction of motion of the motor during forward drive will be referred to as a positive direction and the direction of motion of the motor during reverse drive will be referred to as a negative direction.

During reverse drive, of the powertrain of Figure 1, the ring gear will be driven in the reverse direction. Thus, the angular velocity vector in the above sketch extends to the left. The engine then is on, so the sun gear, during reverse drive, is driven in the positive direction. Since the sun gear is directly connected to the generator, the generator also is driven in the positive direction, as indicated by the relatively large angular velocity vector  $\omega_g$  extending to the right in the above sketch.

As seen in the above sketch, a small engine speed  $\omega_e$  will result in a relatively large generator speed during reverse drive with the engine on. During this operating mode, the generator is controlled to function as a generator. This ensures that the engine will run at its desired speed. Since, as noted from the above sketch, the generator speed is relatively high, either the engine must be operated only at a very limited speed, or the engine must be shut off, lest the generator speed would exceed its maximum value. This feature limits the ability of the powertrain illustrated in Figure 1 to achieve adequate reverse drive performance under certain operating conditions. This characteristic is avoided by the present invention illustrated in Appellants' Figures 2 and 3, in which the engine can drive the generator to charge the battery, which in turn powers the motor during reverse drive. This feature is achieved by isolating the driving connection between the motor and the traction wheels from the power delivery between the engine and the generator. This isolation is achieved by disengaging clutch 62 in Appellants' Figure 2 embodiment and by disengaging clutch 90 in Appellants' Figure 3 embodiment. Further, Appellants' Figure 2 embodiment will provide a reaction point for the ring gear 48 by engaging brake 60. This permits the engine to drive the generator with an overdrive ratio between the engine and the generator. In the case of Appellants' Figure 3 embodiment, a direct driving connection is established between the engine and the generator, during reverse drive with the clutch 90 disengaged, by engaging clutch 88.

The gearing ratio between the ring gear and the carrier is represented in the above sketch by the symbol  $p$ . The gearing ratio between the carrier and the sun gear is represented as unity.

Shown also in the above sketch is a lever analogy for ring gear torque, carrier (engine) torque and sun gear (generator) torque when the powertrain of Figure 1 is operated in reverse with the engine on. As indicated, the ring gear torque vector is negative (i.e., it extends to the left) as a result of the positive engine torque (i.e., engine torque vector extends to the right). The sun gear torque vector is negative (i.e., it extends to the left).

The motor is used, as previously explained, to drive the vehicle in reverse. Because of the negative ring gear torque illustrated in the sketch, the motor must overcome the

effect of the negative ring gear torque as the motor drives the traction wheels in a reverse driving direction. This characteristic diminishes the reverse driving performance of the vehicle. This characteristic of the powertrain of Figure 1 is avoided by the present invention illustrated in Figures 2 and 3.

#### **VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL**

Claims 1-11 are rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent 5,887,670 in view of U.S. Patent 5,846,155.

#### **VII. ARGUMENT**

**A. Claims 1-11 are patentable under  
35 U.S.C. § 103(a) over U.S. Patent  
5,887,670 in view of U.S. Patent 5,846,155**

**(1) Claims 1-11**

It is the Examiner's position that the primary reference '670 patent is similar to Appellants' hybrid electric vehicle powertrain defined by claims 1-11. The Examiner indicates that the primary reference '670 patent lacks a teaching of a reaction brake that anchors a ring gear during reverse driving power delivery mode. The Examiner states that such a reaction brake is taught by secondary reference patent '155.

The Examiner indicates on page 3 of the final rejection that the '670 patent does not disclose a reaction brake that anchors a ring gear during reverse drive. The Examiner states that such a brake is taught by secondary reference patent '155 and that a clutch is disclosed to effect, when engaged, a forward drive split-power delivery mode.

The statements of the Examiner identified by the first four bullet points on page 2 of the final rejection refer to the '670 patent, which discloses an engine, a motor-generator, a battery and a geared transmission, and are accurate. All of the other statements of the Examiner are incorrect. Specifically, the '670 patent does not disclose a "first reaction brake", nor a "clutch between the ring gear and a torque output element (26)". Further, the engine,

with the clutch disengaged, does not charge the battery; the second reaction brake does not anchor the ring gear during operation in a split delivery mode; and a second reaction brake does not act on the sun gear 16<sub>s</sub> during engine starting.

It is Appellants' understanding that the Examiner states that the '670 patent discloses an engine 12, a motor/generator 14, a battery shown in Figure 7 of the '670 patent at 58/136, a geared transmission including planetary gearing 16 with a ring gear 16<sub>r</sub> coupled to the engine and a sun gear coupled to a rotor shaft 14<sub>r</sub>, a first reaction brake B<sub>0</sub> anchoring the ring gear 16<sub>r</sub> as the engine drives the generator, and a clutch CE<sub>1</sub> between ring gear 16<sub>r</sub> and torque output element 26. These statements are incorrect.

The Examiner states further that the motor 14, with clutch CE<sub>1</sub> disengaged, is isolated from ring gear 16<sub>r</sub> during reverse drive and that the engine drives the generator to charge the battery through a torque flow path that is isolated from a reverse drive torque flow path. That statement also is incorrect.

On page 3 of the final rejection dated April 7, 2006, the Examiner refers to a second reaction brake and a second clutch, but these elements are not apparent to Appellants by reading the '670 patent.

The Examiner states that the '670 patent discloses an engine 12, an electric motor-generator 14, a battery and a transmission that includes a carrier, a ring gear and a sun gear. The '670 patent does not include, however, a first reaction brake that anchors the ring gear 16<sub>r</sub>. Further, the '670 patent does not include a clutch between the ring gear 16<sub>r</sub> and a torque output element 26, as indicated by the Examiner. Indeed, the element 26 is connected to the carrier 16<sub>c</sub>, not to the ring gear 16<sub>r</sub>. Further, contrary to the Examiner's statement, the motor 14 of the '670 patent, with the clutch CE<sub>1</sub> disengaged, is not isolated from the ring gear during reverse drive. The motor actually is connected to the sun gear 16<sub>s</sub>. Reverse drive in the powertrain of the '670 patent is achieved entirely independently of the motor 14. Reverse drive is obtained by engaging clutch C<sub>0</sub>, C<sub>2</sub> and brake B<sub>4</sub>, together with one-way clutch F<sub>0</sub>. These clutch-and-brake elements are located in downstream planetary transmission sections 20

and 22, which are entirely independent of section 24 of the powertrain of the '670 patent. Section 24 is identified in the '670 patent as an "electronically controlled torque converter".

The Examiner further states that a second reaction brake is disclosed in the '670 patent for anchoring the ring gear as the engine drives torque output element 26 with the clutch CE<sub>1</sub> engaged during a split delivery mode in a forward driving direction. This statement by the Examiner is not understood by Appellants since, by definition, a split power delivery mode would not require a second reaction brake for anchoring the ring gear. Further, there is no recitation in Appellants' claims of a so-called second reaction brake for anchoring the ring gear during a split delivery mode.

Both the primary '670 patent and the secondary '155 reference patent include only a single electric machine. The single electric machine, shown at 5 in the '155 patent, as well as the single electric machine shown at 14 in the primary '670 patent, can act as a motor-generator. Appellants' invention, in contrast of the teachings of the references, requires two electric machines. One is identified as a generator and the other is identified as a motor. Both of these electric machines can act as either a motor or a generator. For example, during forward split power delivery, the generator acts as a generator and the motor acts as a motor. When the engine is being cranked in a starting mode, the generator can act as a motor. The motor 74 and the motor 74' of Appellants' invention each can act as a generator during vehicle coasting as it captures regenerative energy and stores it in the battery, although this characteristic is not relevant to the claimed invention.

It is emphasized that each of Appellants' claims requires a generator that is separate from a motor. It is impossible to apply the language of the claims to either of the references, taken alone or in combination, since each of them discloses only a single electric machine.

In Appellants' system as defined in claims 1-11, the motor is a power source during reverse drive, not the engine. During reverse drive, reverse drive performance is improved because the motor can be isolated from the driving connection between the engine and the generator. This isolation is achieved by disengaging the clutch 62 in Appellants'

Figure 2 embodiment and engaging brake 60. In the case of the embodiment of Figure 3, this isolation is achieved by disengaging clutch 90 and engaging clutch 88. Clutch 62 and brake 60 are recited in paragraph 6 of claim 1 and, clutch 90 and clutch 88 are recited in the last two paragraphs of claim 2.

Since the planetary gear unit of Appellants' construction is disconnected from the final drive, there is no negative torque for the motor to overcome during a motor launch when the motor is driving the vehicle in reverse with positive torque. Further, the generator, acting as a motor, can crank the engine. This function is effected by the recitals in dependent claims 6 and 7.

Any attempt to apply the language of Appellants' claims to either of the references, taken alone or in combination, would require a double inclusion. That is, it would be necessary to refer to the single electric machine 14 of the '670 patent or the single electric machine shown at 5 in the '155 patent, as both a motor and a generator. That would be an improper claim construction. No element-by-element comparison of the invention to the references then would be possible.

The teachings of the '155 patent contain no suggestions for modifying the design of the '670 patent so that the design of the '670 patent could include a reverse motor drive that is independent of and isolated from the torque flow path between the engine and the generator as in Appellants' design.

The Examiner further states that the teachings of the secondary reference '155 patent, together with the '670 patent teachings, would make it obvious to a person skilled in the art at the time Appellants' invention was made to provide multiple modes of operation by designating a motor mode to drive a vehicle using the motor-generator while the engine is an idle state to enhance efficiency. Actually, this statement of the Examiner is irrelevant because if the engine is in an idling state, it obviously would not be capable of driving the generator to charge the battery to power, in turn, the motor. The Examiner's statement is impossible for Appellants to understand.

The references cited by the Examiner, taken alone or in combination, cannot possibly achieve the operating characteristics of Appellants' claimed invention since there is no counterpart in the references for Appellants' brake 60 and clutch 62 in Appellants' Figure 2 embodiment, and there is no counterpart in the references for clutches 88 and 90 in Appellants' Figure 3 embodiment. Further, there is only a single electric machine disclosed in each reference patent, which makes it impossible to achieve enhanced reverse drive performance in the reference patent designs.

The recitals in Appellants' claims 1-11, outlined above, are not taught by the cited references. Neither are they even remotely suggested by the references. A person skilled in the art certainly would not be motivated to refer to them if that person were to be confronted with the task of enhancing reverse drive performance in a hybrid electric vehicle powertrain and with the task of driving a generator with an engine as a motor, which is an electric machine entirely distinct from the generator, drives vehicle traction wheels.

**(2) Claim 3**

As indicated previously, claim 3 defines clutch 88 of the embodiment of Figure 3. That clutch establishes a direct drive in the planetary gearing to permit the engine to drive the generator in a torque delivery path that is isolated from the torque delivery path for the motor. This feature is clearly lacking in the reference teachings as explained above.

**(3) Claim 4**

Claim 4, which is dependent on claim 1, defines a planetary gear set, a clutch that completes a geared torque flow path between the engine and the traction wheels during forward drive and a brake that anchors the ring gear when the generator is driven by the engine in the embodiment of Figure 2. As previously pointed out, neither reference discloses this feature.

**(4) Claim 5**

Claim 5 is a dependent claim that defines the embodiment of Figure 3. It recites the second clutch that is engaged during forward drive. There is no counterpart for this feature disclosed in the references as indicated above.

(5) **Claim 8**

Claim 8 defines the front clutch shown in the embodiment of Figure 3 that is engaged when the generator is being charged by the battery. There is no counterpart for this feature disclosed in the references.

(6) **Claim 9**

Claim 9 defines countershaft gearing for the embodiment of Figure 2. Neither of the cited references describes countershaft gearing.

(7) **Claim 10**

Claim 10 defines countershaft gearing for the embodiment of Figure 3. Neither of the cited references describes countershaft gearing.

The Examiner has relied upon 35 U.S.C. § 103 to support a rejection of claims 1-11 based on obviousness. Appellants' position is that the Examiner's rejection based on obviousness is contrary to long-standing case law developed by the Court of Appeals for the Federal Circuit. The rejection based on 35 U.S.C. § 103, furthermore, is not in compliance with established practice within the United States Patent and Trademark Office with respect to § 706.02(j) of the Manual of Patent Examining Procedure.

A rejection based upon 35 U.S.C. § 103 must establish a *prima facie* case of obviousness based on three criteria. First, there must be a suggestion in the prior art, or in the knowledge generally available to a person skilled in the art, to modify the basic reference teachings or to combine reference teachings. In the present case, the basic teachings of the '670 patent do not refer to a powertrain that is capable of performing the operating features of the present invention discussed in the preceding arguments. For example, the basic reference does not disclose a powertrain in which reaction torque on a gear system of a hybrid electric vehicle torque flow path can be isolated from the torque flow path between the traction motor and vehicle traction wheels, as the traction motor operates in a reverse direction to achieve reverse vehicle drive. In the absence of this feature, the basic reference '670 patent of necessity lacks a teaching of a powertrain system in which an engine can drive a generator to charge a battery for powering the traction motor in reverse drive without adversely affecting

the reverse drive performance of the vehicle. The Examiner's reliance on the secondary reference '155 patent does not supply this deficiency in the '670 patent teaching.

At the outset, a combination of references in a rejection based on 35 U.S.C. § 103 requires a showing of a suggestion in the prior art for the combination of references together with an expectation of success. *In re Dow Chemical Co.*, 837 F.2d 469 (Fed. Cir. 1988). There must be some reason or suggestion or motivation found in the prior art that would lead a person skilled in the art to make a combination of reference teachings. *In re Oetiker*, 977 F.2d 1443 (Fed. Cir. 1992). In the present instance, there is no teaching in the cited prior art that would suggest to a person skilled in the art that a ring gear reaction element could be added to the teachings of the '670 patent, as indicated in the final rejection. The fact that the '670 patent has been combined by the Examiner with the '155 patent is an indicator that hindsight was used in an attempt to support an obviousness rejection. Such a rejection has been held numerous times by the Federal Circuit to be improper. *Panduit Corp. v. Dennison Mfg. Co.*, 810 F.2d 1561 (Fed. Cir. 1987).

Regardless of the foregoing, Appellants respectfully suggest that even if a combination of the type indicated in the final rejection were to be made, the resulting structure would be incapable of performing the reverse drive enhancement characteristics described in the foregoing arguments. Clearly, the structural elements that are needed to perform the reverse drive enhancement of Appellants' invention require a motor that is separate from the generator. Each of the references, as previously indicated, clearly would be incapable of performing this reverse drive performance enhancement feature because the structures disclosed in each of the references have only a single electric machine.

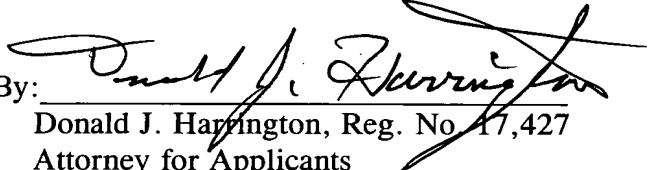
The lack of any structural similarity between Appellants' invention and the powertrains illustrated in the references, taken alone or in combination, make it impossible to apply the well-established test of *Graham v. John Deere Co.*, 383 U.S. 1 (1966), in any comparison of Appellants' claimed invention with a powertrain that might result from a combination of the '670 and '155 patent reference teachings.

**VIII. APPEAL BRIEF FEE**

The fee of \$500.00 applicable under the provisions of 37 C.F.R. § 41.20(b)(2) should be charged to Ford Global Technologies, LLC Deposit Account No. 06-1510. Please charge any additional fee or credit any overpayment in connection with this filing to Deposit Account No. 06-0510.

Respectfully submitted,

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Date: September 7, 2006

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Enclosure - Appendices

## **IX. CLAIMS APPENDIX**

1. A hybrid-electric wheeled vehicle powertrain comprising an internal combustion engine, an electric motor, an electric generator and a battery;

the electric motor, the electric generator and the battery being electrically connected to form an electrical power source;

a geared transmission defining power flow paths to vehicle traction wheels, the geared transmission having a first element connected drivably to the engine and a second element connected drivably to the motor;

a rotor for the generator being connected to a third element of the geared transmission; and

a reaction brake for anchoring the second element of the geared transmission as the engine drives the electric generator during operation of the powertrain in a reverse driving power delivery mode, the electric motor being drivably connected through the geared transmission to the vehicle wheels;

the driving connection of the second element of the geared transmission to the motor comprising a clutch between the second element of the geared transmission and a torque output element of the powertrain whereby the motor, with the clutch disengaged, is isolated from the second element during reverse drive;

the reaction brake for anchoring the second element of the geared transmission being released and the clutch being engaged during operation of the powertrain in a split-power delivery mode in a forward driving direction.

2. A hybrid-electric wheeled vehicle powertrain comprising an internal combustion engine, an electric motor, an electric generator and a battery;

the electric motor, the electric generator and the battery being electrically connected to form an electrical power source;

a geared transmission defining power flow paths to vehicle traction wheels, the geared transmission having a first element connected drivably to the engine and a second element connected drivably to the vehicle traction wheels;

a rotor for the generator being connected to a third element of the geared transmission; and

a first clutch selectively connecting two elements of the geared transmission thereby establishing a direct drive between the engine and the electric generator as the engine drives the electric generator during operation of the powertrain in a reverse driving direction, the electric motor being drivably coupled through the geared transmission to the vehicle wheels;

the driving connection of the second element of the geared transmission to the vehicle traction wheels comprising a second clutch between the electric motor and the gear elements of the geared transmission, the second clutch being disengaged and the first clutch being engaged during reverse drive operation whereby the engine drives the generator to charge the battery through a torque flow path that is isolated from a reverse drive motor torque flow path.

3. The hybrid-electric wheeled vehicle powertrain set forth in claim 2 wherein the first clutch connects the first and second gear elements of the geared transmission to achieve a direct drive in a torque delivery path between the engine and the generator as the engine drives the generator to charge the battery.

4. The hybrid-electric wheeled vehicle powertrain set forth in claim 1 wherein the geared transmission has a planetary gear set including a sun gear connected to the generator, a ring gear, and a carrier connected to the engine;

the clutch, when engaged, completing a geared torque flow path between the engine and the vehicle traction wheels during forward drive operation,

the reaction brake anchoring the ring gear when the generator is driven by the engine.

5. The hybrid-electric wheeled vehicle powertrain set forth in claim 2 wherein the geared transmission has a planetary gear set including a ring gear, a sun gear connected to the generator and a carrier connected to the engine;

the second clutch completing a torque flow path between the ring gear and the vehicle traction wheels during forward drive operation.

6. The hybrid-electric wheeled vehicle powertrain set forth in claim 1 wherein the reaction brake acts on the second element of the geared transmission to effect engine starting torque delivery from the generator to the engine as the generator functions as an engine starter torque source.

7. The hybrid-electric wheeled vehicle powertrain set forth in claim 4 wherein the reaction brake anchors the ring gear of the geared transmission to effect engine starter torque delivery from the generator to the engine as the generator functions as an engine starter torque source.

8. The hybrid-electric wheeled vehicle powertrain set forth in claim 5 wherein the first clutch connects the carrier and the ring gear of the geared transmission to achieve a direct drive in a torque delivery path between the engine and the generator as the engine drives the generator to charge the battery.

9. The hybrid-electric wheeled vehicle powertrain set forth in claim 1 wherein the geared transmission includes countershaft gears in a power flow path between the motor and the torque output element of the powertrain and between the second element of the geared transmission and the motor.

10. The hybrid-electric wheeled vehicle powertrain set forth in claim 2 wherein the geared transmission includes countershaft gears in a power flow path between the

motor and the traction wheels and between the second element of the geared transmission and the motor.

11. A hybrid-electric wheeled vehicle powertrain comprising an internal combustion engine, an electric motor, an electric generator and a battery;

the electric motor, the electric generator and the battery being electrically connected to form an electrical power source;

a geared transmission defining power flow paths to vehicle traction wheels, the geared transmission having a first gear element connected to the engine and a second gear element connected drivably to the motor;

a rotor for the generator being connected to a third element of the geared transmission;

means for establishing a driving connection between the engine and the generator through the gear elements during operation of the powertrain in a reverse driving power delivery mode, the electric motor being drivably connected to the vehicle traction wheels; and

means for isolating a torque flow path between the motor and the vehicle traction wheels from a torque flow path between the engine and the generator.

**X. EVIDENCE APPENDIX**

**None**

**XI. RELATED PROCEEDINGS APPENDIX**

**None**